INCUBATION

P. COOK

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A Working Manual for Large Hatching Plants

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THE WEIMAR PRESS, *Publishers*
Alhambra, Los Angeles, Calif.

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INTRODUCTION.

Artificial incubation of the eggs of domestic fowls has been practised from time immemorial in both Egypt and China.

In the United States probably more patents have been taken out on incubators than on any other kind of machinery, yet, taking the country over, there are enormous losses of fertile eggs which would have produced strong and vigorous chicks had they been placed under hens. There is every reason to think that American hatches are even considerably below those of Egypt and China.

On the other hand, all hatcheries and all incubators have at times produced hatches in every respect equal to those of the setting hen. The puzzle has been why they only succeed sometimes and fail so often when apparently the treatment is the same in all cases. The trick in artificial hatching is to be able to hatch every fertile egg (not only once in a while) but every time the incubator is set. This little book is written to clear up the causes of failures, for there is no reason why artificial incubation should not be fully as reliable as natural incubation.

I have run incubators without intermission for nearly twenty years and I have had my share of failures and bitter disappointments, but for three years now our plant, holding forty thousand eggs, has been run for nine months every year without a single poor hatch and therefore I feel that in all essentials we must be on the right road. Each year during this long period I have not only conducted careful investigations, but have built from two to four different types of incubators with the hope of overcoming the frequent failures. In many cases the only result of much toil was merely to find another way which does not work. There is no end to the wrong things that can be done in a hatchery, and unfortunately there is only one right way.

It certainly has been a wearisome search to find this right way. Let us first of all try to understand why research work in a hatchery or a poultry plant so seldom leads to positive results.

The methods and standards of the physical and chemical laboratory are altogether inapplicable when we are dealing with living organisms, for they have a considerable range of adaptibility to varying conditions of life, under which they can still survive. Hens, for instance, can live both in winter and in summer. A temperature between 50 and 75 degrees leaves them unaffected, but below or above that they begin to be uncomfortable. But probably they thrive best of all in a

temperature between 60 and 70 degrees. Above all things the successful poultrymen needs to know exactly under what conditions his fowls thrive best.

So in an incubator, living embryos can adapt themselves to a rather wide range of conditions. They can suffer for lack of air, or lack of turning the eggs, or be roasted in too high a temperature and still hatch. So long as they recover, the operator may never know the damage he does. The argument that his chicks hatch under his method does not by any means prove that he has not done them injury. A reckless driver may argue that he can drive within a few inches of the precipice without falling over, but that is no reason why he should drive there. It can safely be said that the methods of incubation hitherto universally practised do great damage to the chicks in spite of the fact that sometimes the hatches are very good. The frequent failures which all operators experience prove decisively that something is wrong, that there is altogether too much driving near the precipice. What I am describing in this book are methods of hatching that show the middle of the road where it is safe all the time and where success is certain in every hatch. If there is failure at all it is due to the eggs, not to the incubator. The proof in this case is that setting hens do no better. So long as the setting hen hatches better chicks the incubator needs improvement. Practical considerations make it impossible altogether to equal the hen, but we can come very close to her. It should need no argument that all methods of incubation which depart widely from conditions under the hen should not for a moment be tolerated by any intelligent poultryman.

So long as the chick's powers of recovery are not seriously overstressed statistical investigations remain without results, yet in the long run it may make a great deal of difference whether you are driving in the middle of the road or on the edge of the precipice.

TURNING THE EGGS.

To illustrate: It was for many years a question in our hatchery whether the best practice was to turn eggs once, twice, or three times daily. Time after time one tray was turned once, the next twice and the third three times daily in the same incubator, but when the final statistical results were tabulated, there either was no decisive difference at all, or it might be in favor now in this now in that tray. So there was no clue in which direction the middle of the road lay. We were still in the days when every once in a while a bad hatch would come up.

The fact of the matter is that when eggs are strong, as from range-bred stock, in the spring of the year, eggs hatch tolerably well, if they are never turned at all, but simply left in the incubator under proper heat and ventilation. Embryos do not stick to the shell because eggs are not turned as is so popularly believed. Some always do stick to the shell in spite of turning. Eggs which do this have the albumen broken and nothing can save them.

In this case our clue came in a different way. Once our whole immense hatch was turned only twice a week and the eggs slightly moved once a day without turning. Result: a poor, straggly hatch. We knew definitely then that there was not enough turning. The next hatch was two weeks along and had been treated similarly, turned only once or twice a week. Immediately this hatch was turned three times daily for the remaining last week. The R. I. Reds in this case hatched normally. The three-times turning the last week only was sufficient to allow them to recover. The White Leghorn eggs, however, did not respond, but hatched badly as before. It was the fall of the year and moulting time and the Leghorns were naturally weak, as in addition the eggs were all from closely confined birds.

The following hatch was only one week advanced at this time. It was turned three times daily for the remaining two weeks. In this case both Red and White Leghorns hatched normally. After this all our eggs have been regularly turned three times daily and no bad hatches have appeared. In the long run the chicks from three-times daily turning are far larger and stronger than those which are turned only once or twice daily. Where eggs are turned three times daily the entire hatch will be clean. There will be no chicks with unabsorbed albumen, while in cases where eggs are turned only once or twice daily, there will be more or less chicks with unabsorbed albumen, at any rate during the moulting season.

The effect of turning seems to be to give exercise to the growing embryo, in order to develop its full strength. If an incubator with eggs turned three times daily is tested with our Carbon-Dioxide test, it will be found that its metabolism is far stronger than where eggs are turned only once a day.

Methods of turning which merely shift the position of the embryo manifestly do not secure this result and therefore cannot be recommended. Eggs should be turned clear over, not too roughly. Yet when the hen squats down on the nest she kicks the eggs about considerably before she gets settled and is so rough that she often breaks some of the eggs. Of course, the hen does not turn her eggs, but she moves them about considerably both in getting on and off the nest and while she is setting on them.

There is no doubt that turning three times daily is quite essential to secure the strongest and largest chicks possible. Turning should begin twelve hours after the eggs have been set and continue till they begin to pip or a few early chicks are out of the shell.

When about 25 per cent have begun to pip it is a good plan to take the tray out of the incubator and place all pipped eggs with the chipped side upwards. Do not allow any eggs to stand with small end up during the hatch. Let eggs lie flat on the tray with large end slightly elevated.

It does not hurt to open the incubator door while chicks are hatching.

THE RIGHT TEMPERATURE OF INCUBATION.

One of the most important things in incubation is the proper temperature. How our American thermometers came to be marked for 103 degrees Fahrenheit as the right incubating temperature and allowing a range as high as 105 degrees, I do not know. And the European thermometers in use even allow a still higher temperature. Long experience in hatching has established nothing more definitely than the fact that these temperatures are much too high. An enormous number of White Leghorn embryos die in the shell for no other reason than that they are incubated at 103 degrees. Reds and Rocks and the heavier breeds generally, can fairly survive this temperature, especially if they get some relief by twice-a-day cooling.

Many operators have found that extra cooling helped the hatch, but that is due only to the fact that they were incubating at too high a temperature. Nothing is so harmful and so weakening to the embryos as continued high temperature, even if this is not more than one degree too high. One degree too high throughout the hatch is far more harmful than 108 to 110 degrees for a short time, say one or two hours.

In cannot detail here the weary search we have had for the right temperature, but can only say that for most incubators best results are secured when the hatch is run between 100 and 102 degrees. It is impossible to run any machine much closer than a variation of two degrees. In this the average should fall slightly below 101 degrees. The important point is never to exceed 102 degrees for any length of time. Eggs can stand lower temperatures much better than too high heat. We once had a battery of incubators which was forgotten for two days around the eighth day of incubation. The heat had been turned off from the machines under the supposition that the eggs had been shifted to another room. When they were discovered, after 48 hours, they were slowly reheated and hatched about 50 per cent of normal good chicks and 25 per cent weaklings and culls.

However, cooling eggs below 95 degrees must always be considered more or less detrimental. The setting hen does not usually leave the nest over five to ten minutes and her eggs in the nest on the straw or other litter do not cool nearly as quickly as a tray of eggs taken out of the incubator with cold air rushing around the eggs from all sides. The ordinary cooling of eggs by taking the trays out of the incubator must be considered as detrimental. We have secured much better hatches after abandoning that plan. We have not been able to find any evidence that such extra cooling of the eggs helps, but opening the doors of the incubator for five to ten minutes while turning or shifting eggs is very beneficial in most commercial incubators, because they are almost always deficient in ventilation, and opening of the doors supplies the fresh air so badly needed. If the doors are left open more than five or ten minutes at a time the eggs near the front will hatch behind time. But five minutes opening three times a day has no effect

on the time of the hatch. And this slight cooling of eggs in the incubator may have a greatly beneficial effect.

Ther are many other points which must be remembered in this connection. When we speak of 100 to 102 degrees of temperature we mean it as given by the ordinary heavy-bulb thermometer placed with the bulb level between the top of the eggs and not touching the eggs. A clinical thermometer placed in the same position will read differently, generally almost a degree lower, even if the two read identical in a water-bath.

After the 18th day all thermometer readings become more or less unreliable, for the embryos are always hotter than any thermometer reading, and the small end of the egg at this time is much hotter than the large end with the air-cell. The normal temperature of the full-grown embryo is probably the same as that of the hen, viz. between 105 to 107 degrees Fahrenheit. After the 18th day of the hatch it is best to disregard the thermometer altogether and run the machine exclusively by the regulator. See that on the 17th day the thermometer is placed near a fertile egg, but not touching it and set your regulator to hold the machine at 102. After that disregard the thermometer for the rest of the hatch.

The broody hen has no higher temperature than the non-broody bird. The normal temperature of the hen has never been exactly determined, our own tests range from 105 to 107 degrees Fahrenheit, and other authorities report the same result. There is no such thing as a broody fever. While the blood temperature of the hen ranges around 106 degrees, she is not able to impart this temperature to the eggs on which she sits, for the same reason that if you set a hot flatiron on top of a cold one, you cannot heat the lower to the same degree as the upper one. A considerable amount of heat dissipates into empty space. So with the hen. Some of the eggs of her clutch directly under her breast may reach 103 or perhaps even 104 degrees, but those on the outer part of the cluch seldom reach more than 95 degrees. In the haphazard shifting the eggs receive under the hen this temperature is fairly equalized to amount to the average of about 101 degrees.

Another matter that must be taken into consideration is the temperature of the incubator underneath the egg-trays. This should not be lower than 95 degrees, nor should it be higher than 102 degrees at any time. Nor, when chicks are dropping into hatching drawers, the bottoms of these drawers must not be more than 95 degrees. The common commercial incubator, of course, has far too cold a bottom. These cold bottoms are the fruitful causes of cripples and the development of white diarrhea. If the under side of the eggs is too cold during the period of incubation, cripples result. If chicks drop into too cold nurseries, they get chilled and great brooder mortality is the result. No doubt, white diarrhea is a bacillary disease, but the theory that it is transmitted from the hen through the egg needs still much more evi-

dence than has ever been adduced. In practical poultry raising, white diarrhea is due to chilling the chicks or sweating them in the incubator or in the brooder. Chicks then are weakened and become the helpless prey of the diarrhea bacillus, which in the normal state they would be able to resist. Hatch your chicks right and give them a comfortable brooder, with not more than 100 in a run, and you need lose no sleep for fear of white diarrhea.

All incubators should have their bottoms heavily padded with haircloth, or cotton-wool, or chaff, etc. If the incubator is operated in a room of 70 degrees temperature this padding is sufficient. If the room is colder, the bottom should be slightly heated by running hot-water pipes underneath the machine, or making a double bottom with a four inch space and placing electric light globes at suitable intervals therein.

Another highly important matter is to see that your incubating heat is a mild and gentle heat. The ideal incubator should have no heating element that can ever get warmer than the body of the hen. In actual practice we cannot quite accomplish it, but it is very important not to transgress this law too far. No incubator pipe should ever be allowed to be hotter than it can be held in the hand without causing pain. Do not attempt to heat an incubating chamber with a small hot pipe. Have the size large enough, or sufficient coils so that the circulating water does not need to be more than warm. Boiling water in the pipes will overheat the eggs even though the thermometer does not register too high a temperature. In other words, boiling hot water in the circulating system heats the eggs too quickly, and this is quite as detrimental as overheating them. Many an incubator operator, whose heating system is too powerful, wonders why he has poor hatches. The fact is, he heated his eggs too rapidly when placed in the machine, and every time he cooled them he repeated this too-rapid heating. The heating system must always be kept so low as barely to provide just sufficient heat to be enough at its maximum. Nearly all electric incubators hitherto manufactured have failed so miserably because the heat is too fierce. On electric incubators there should always be a rheostat to cut the heat down in the heating elements.

In our own hot-water machines we use a regulator in the water pipes in addition to the regulators in the egg-chamber. The reason is that the regulators in the egg-chambers cannot prevent too rapid heating. They can reduce the heat the moment it comes to the degree for which they are set, ,but they cannot slow down the process before that time. Our hot water regulators cut the heat off the moment the water in the pipes reaches the temperature for which they are set. It will then be still several hours before the regulators in the egg-chambers get into action, for since the water cannot get any hotter the incubating chamber must take time in heating up.

When eggs are first set, it should take from six to eight hours before they reach 102 degrees and it does not hurt if it takes 12 hours. Turn your flame low enough when you start the machine to secure this result and never run the flame any higher than absolutely necessary. Gas flames as a rule are far too powerful. Use the lowest burner you can possibly get along with. The same with electric heating elements.

In Mammoth Incubators never let the water in your boiler get too hot. Many Mammoth machines are failures in the hands of operators for no other than this reason alone. Many electric machines are fitted with far too powerful heating coils. You cannot hope to get a good hatch until these coils are removed, or the heat reduced by a dependable rheostat. It is not enough to say you can hold the right temperature, it is absolutely necessary that your incubator is so constructed that it will not heat up too rapidly. Incubators operated by coal-oil lamps did not usually fail at this point, for in most cases the lamp was not powerful enough to heat the incubator unless in cold weather the room also was heated. It is always best to have the incubator in a room that never gets colder than 70 degrees. However, in our own plant the room temperature varies from 40 degrees to 100 degrees, yet we have equally good hatches, but our incubators have bottom heat to overcome the cold days, and extra ventilators for the hot days. In other words, our own incubators have ten times the flexibility than the ordinary commercial machine, and therefore can be adapted to extremely varying conditions.

AUTOMATIC TURNING DEVICES.

The great labor in a hatchery comes from the necessity of turning and shifting the eggs constantly. In the ordinary commercial machine, and for that matter also in all the Mammoths, eggs must be shifted from the center to the corners of the trays at least every other day if a really good hatch is to be secured and culls and cripples are to be reduced to a minimum. This is due to the fact that all incubators, in spite of the assertions of the manufacturers and the general belief of operators, have too great a difference of temperature between the center and the corners of the machines. The ordinary difference amounts to from five to eight degrees. Place seven thermometers on your egg tray, one on each corner egg, one on each egg in the center of the row of eggs next the wall and one in the center of the tray. Then notice the difference. Do not think that because one thermometer holds an even temperature all the others do the same. Also an incubator acts very differently when full of eggs from what it does when empty. If you cannot reduce the difference in temperature in your machine to less than two degrees, you cannot hope to operate an automatic turning device successfully, for your eggs must be shifted to equalize the temperature. It is an exceedingly difficult matter to get an incubating chamber that does not vary more than one degree. Our new electric incubators come fairly within a degree anywhere in the incubating chamber and they are the only machines I have ever operated which deliver a whole hatch of perfect chicks without ever shifting the eggs. In these machines there are practically no culls, no cripples, no chicks pipping and then failing to come out, except those drowned where they happened to start pipping on the under side of the egg, or get caught on the bottom of the tray. There are of course about the same number of dead embryos as under the hen.

I will now describe different ways in which the temperature in an incubating chamber can be made more uniform.

No matter how well insulated the machine is, the walls absorb considerable heat which always renders the sides and corners cooler than the center. Glass doors are especially bad and should be abandoned for felted doors. Always open the door to read the thermometer or whenever you wish to see how chicks are hatching. The incubator always needs this breath of fresh air.

A good way to even up the temperature is to tie building paper around the center portion of the pipes. Or screens of galvanized iron or thin boards can be put under the pipes where they are too hot. Or in places where the trays are too cold, one side or even the whole tray may be raised so as to be an inch nearer the heating pipes. Or else the nursery may be more heavily padded in places where the trays are too cold. Or temporarily a chick box or sack or coat may be laid on top of the machines in cold spots. That will raise the temperature a degree or so. A box filled with chicks placed on top of an incubator with eggs

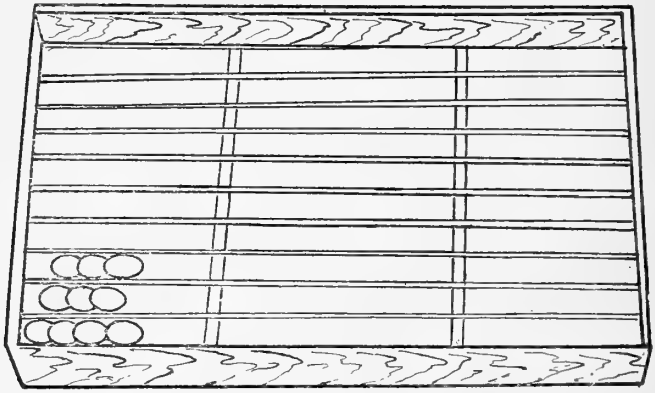
in it often will raise the temperature over that tray from three to five degrees. If you place chick boxes on an incubator, always place the first one directly over the regulator so that it can reduce the heat correspondingly. But if the chick boxes are to remain any length of time they should be distributed evenly, else the machine will have very uneven heat. When electricity is available it pays to put a two-candle power bulb in each corner as an extra heater. This often wonderfully evens up the temperature. These small bulbs can be left to burn continuously as they just about supply the exact corner-heat needed.

In our hot-water machines a blind stub pipe is run down about four inches in the corners, directly open to the circulating system. This stub becomes filled with hot water and supplies the extra heat needed in the corners. In all machines it is necessary to leave off a row of eggs next to the walls in order that the air may circulate freely around the tray. In our own incubators there is a half-inch open space between the trays and the walls. This seems to be sufficient to allow the heat to circulate around the eggs.

But all these provisions are not yet quite sufficient, for after the 12th day the embryos begin to generate a great deal of heat of their own and this heat naturally is much greater in the center of the machine than in the corners. New provisions must now be made to carry off this surplus heat. In our hot-water machines this is accomplished by a two inch hole over the center of every tray holding 150 eggs. After the twelfth day the ventilating slide over the hole is opened. It will not do to try to heat an incubator from the sides and corners only, for until the tenth day or so that leaves the center insufficiently heated if the incubating chamber holds over 200 eggs. In our new electric sectional machine the heating problem has been solved best of all. There are four large heating elements in the four corners and four small heating elements in the centers of the four sidse so spaced as to evenly heat the entire incubating chamber holding three hundred eggs. From the first to the twelfth day all heating elements are used. On the twelfth day the four center elements are switched off and for the balance of the hatch the machine is heated only by the four corner heating elements. Needless to say that these heating elements are reduced to a very mild heat, for all eight of them together are equal only to a single 12 candle power carbon lamp. This is sufficient to heat three hundred eggs and the current then is not on even half the time.

AUTOMATIC TURNING DEVICES.

The success of automatic turning devices depends much more on solving the heating problems within the incubating chamber than on the devices themselves. The reader should be able to see why so many automatic incubators are failures and if he has one of them should be able to see how to remedy the defects.



THE P. COOK AUTOMATIC EGG TURNING TRAY.

It is constructed out of sugar-pine. Sides are made out of ¾ inch stock and are 1¾ inches deep. The ends are of ⅜ material and same depths as the sides... The rest is made of slats ¾ inches deep and ⅜ inches wide. These slats are evenly spaced 1¼ inches apart. The tray has no bottom, but eggs rest on these slats and turn over very easily at a gentle movement of the tray, either forward or backward. Chicks are hatched on these same trays, and drop through the slats into the nursery below them.

There is no turning device so far invented that is quite equal to hand turning, but our own turning tray, which was among the first invented, still is far superior to all others. Its great simplicity and general efficiency are its outstanding features. As we have not patented it, every reader is at liberty to build it for himself. Any one of a mechanical turn of mind can easily construct it. They are made of wood and the illustration indicates sufficiently their construction. Eggs are turned by simply drawing the tray forward rapidly about five inches and then gently stopping it. The eggs then all flop over. To turn the eggs back the operation is reversed. Pull the tray forward suddenly, all the eggs then flop back. It takes a little practice, but soon you can lay the whole lot over as gently as if you turned each egg by hand. To get practice fill a tray with infertile eggs and flop them forth and back

till you can do it gently. I myself turn 40,000 eggs in about twenty minutes and for many seasons never have broken an egg in turning with these trays.

The tray does not need to be filled with eggs and they do not have to be laid in any certain way. But it is best to place them with the big end very slightly elevated. If eggs come to stand with the small end up, they should be placed properly at hatching time, i. e., either flat or the big end slightly elevated. Never have the tray crowded at hatching time. Do not fill trays up after testing out the infertiles. The heat and air both circulate better with plenty of open spaces on the tray.

Chicks drop through the slats into nursery drawers in hatching. In our machines both tray and drawer can be pulled out together with shells and eggs. Or tray can be lifted off first and drawer with chicks then taken out. In our own machines the heat is so evenly distributed that eggs do not need to be shifted or trays ever taken out till the hatch is complete.

The very expensive machinery in the turning devices of many Mammoth incubators do not accomplish the result as efficiently as do these simple trays. Any machine can be made an automatic machine if these trays are built for it and the heat equalized in the heating chambers. This heat equalization must be done for all the Mammoth incubators now on the market after the operator buys them. In many cases, therefore, it does not pay to substitute these expensive machines for the common smaller incubators, since they do not really mark any advance over them.

Of late years huge room Mammoth incubators have come on the market. They can be operated only by hot-blasts, and eggs in them certainly are not under desirable conditions. Chicks were not intended by nature to be hatched like maggots in a garbage can. I know it can be done, just as babies can be born in slums, and grow into manhood and womanhood, nevertheless it is not well for any child to be born in the slum, neither is it well for any chick to be hatched in such contraptions. Nor should they ever be brooded in mobs of thousands. As a fruit grower cherishes his young trees and sees that they are neither harmed, stunted or forced in growth, so should a poultryman cherish his chick as the apple of his eye.

The eggs in these room-incubators are in no better condition than in the common smaller machines, and probably neither under worse conditions. The turning arrangements especially leave much to be desired. The fans should be slowed down to the point where they are just sufficient to distribute the heat evenly, all excess draft is undesirable. Moreover, they should be run under our carbon-dioxide test to see that they have the proper amount of fresh air. But the actual labor in handling a hatch in these machines is considerably greater than in other types of automatic incubators, though of course it is less than in hand-turning machines. The size and unwieldiness are other objections to this type of incubator construction.

VENTILATION.

All animal life-processes derive their energy from oxidation. The embryo within the egg cannot grow without consuming oxygen. In part the oxygen consumed combines with carbon giving carbon-dioxide gas. This gas, being an end-product, can no longer support the oxidation process on which life depends and if not removed, soon chokes the living germ. So during the entire incubation period there must be a constant supply of oxygen and a constant removal of the noxious carbon-dioxide. In other words, fresh air must be constantly supplied to the eggs and foul air carried off through some system of ventilation, or the embryos cannot mature or grow into strong chicks. Lack of sufficient air is the most frequent cause of weak chicks and dead chicks in the shell, if the incubating temperature has been normal.

In this connection no greater stupidity can be conceived than the frequent directions to close the ventilators during the last days of the hatch. Those are precisely the days when the embryos need the most air and ventilators must be wide open at this time. The first week the germs are small and need but an insignificant amount of air. As they grow, they need more air, so the second week ventilation must be increased, and the third week (and especially during the last days) they need air most of all.

All incubators should be fitted with sufficiently large ventilators having movable slides by which the amount of air they admit can be controlled and the rule for ventilation with all types must always be this: 1st—*Keep the machine entirely closed the first five to seven days;* 2nd—*Keep ventilators half open the second week, and* 3rd—*wide open all during the last week and especially during the hatch.*

Where ventilators cannot be controlled, either the eggs have far too much ventilation during the first period of incubation, or else they have far too little during the last period, However, it is much less dangerous to err on the side of too much ventilation than not enough. Lack of sufficient air during the last two days of incubation either kills the chicks outright in the shell, or else so seriously weakens them that they cannot be successfully raised in the brooder.

The right amount of ventilation should not be guessed, but be determined for each incubator in the place where it is intended to be used by our Carbon-Dioxide test. This instrument measures the ventilation in an incubator as accurately as any thermometer measures the temperature. The range of ventilation under which embryos can thrive is fortunately very wide as compared with the range of the temperature of incubation. So after the habits of an incubator have once been determined, only an occasional test as a check is necessary. Our own incubators sold to the public have all been tested by the carbon-dioxide test and can fairly well be run without this instrument.

If you do not wish to buy this instrument the following rules can be used as a rough sort of guide. Your incubator should have a two

inch opening, or its equivalent, in the center of every tray holding 150 eggs. It should have an intake of a five-eighth inch hole underneath every tray holding 150 eggs. These openings should all be closed the first week, half open the second week, and fully open the last week. This gives about the right ventilation for 150 eggs in a room temperature of 70 degrees. If the room is colder the ventilators must be reduced a little. If the room is warmer the door must be opened for a few minutes every four hours to completely change the air. If the room temperature goes above 85 degrees hook the door of your incubator so that it leaves a crack of about an inch wide opening. Above 85 degrees all ventilators on all incubators cease to function and the only thing that can be done to supply air is to open the doors. And this must be done even though chicks are coming out of the shell. If your incubator stands in a room where on a hot summer day the room temperature reaches above 85, open your incubator doors from one to two inches wide and let them stand that way open as long as your room is hot. You cannot bring off a hatch in that room temperature without open incubator doors, or your chicks will die in the shell or become seriously weakened from carbon-dioxide poisoning.

If all fresh air is shut off from a 19-day embryo, it will die from carbon--dioxide poisoning in fifteen minutes, so see that your hatching embryos have enough air to breathe. It is always well to open the incubator door frequently during the hatch. It helps to give the chicks the air they so badly need. If the weather is cold the door should be opened only a second or two, if it is warm leave it open correspondingly.

It does not make any particular difference which system of ventilation is in use. The main point is somehow to get enough air to your chicks. But after this much has been said, it must also be remembered that it is highly desirable that all ventilation in an incubator should be draftless. Too much draft dries out the eggs too much and the embryos cannot grow for lack of the necessary water. The only way to get draftless ventilation is on the principles of a cubic box without a lid. The wind can blow over this and the air be perfectly calm at the bottom. It is for this reason that we prefer a single large opening on top of the incubator, and no opening at all or only a very small one at the bottom. The bottom opening is more for emergency purposes than anything else. Ventilation in an incubator should be by diffusion of gases, as it is under the hen, rather than by circulation. For this reason we cannot regard the forced draft incubators as at all desirable. But forced and circulating air is better than insufficient air. But why not build your incubator right at every point?

Unabsorbed albumen is one of the first signs that your eggs suffered for lack of air. Embryos dead in the shell in greater number than under the hen is another sure sign that chicks lacked air. Here it must be borne in mind that dead embryos under the hen often do reach as high as 30 per cent of a clutch and they have occasionally reached even 60 per cent. In such cases the breeding stock must be looked into.

Tough shells, after the chicks have hatched, is another indication of lack of air.

It is out of the albumen that the body of the chick is built up. It contains over fifty per cent carbon. Part of the carbon goes to form the body of the chick, the other part unites with oxygen and becomes carbon-dioxide gas, meanwhile releasing energy for the growth of the chick. After the union of these two gases their energy is spent. They are of no further use to the organism and must be removed. The spent carbon-dioxide passing through the shell breaks down its constitution and when the chick has had a vigorous growth and breathing strongly while in the shell, the relatively enormous amount of carbon-dioxide passing through the shell leaves it very weak and brittle at the end of the incubating period.

The weaker chick breathes less, produces less carbon-dioxide and the shell, (if the chick gets out at all) is tough, or a portion of the albumen is left which it was not able to use up and build into its body for lack of air.

Because the air-supply in an incubator is so important, we give here a complete description of the carbon-dioxide test which I invented more than ten years ago and which has so greatly contributed to our success in hatching baby chicks.

THE P. COOK CARBON-DIOXIDE TEST.

The amount of air which filters or passes through an incubator depends on a number of things, but chiefly on the difference of the temperature inside the machine and that outside of it. The warm air escapes the faster from every hole or crevice, the colder the room outside is. Cracks around the doors and elsewhere play often as much, if not greater part, than the ventilators themselves. In a freezing room hardly any incubator can be shut tight enough to prevent too great a stream of air from passing through it. On the other hand, in a room where the temperature runs to 90 or 100 degrees all ventilation will stop, because there is not enough difference between the incubator- and room-temperature to cause an exchange of air. Chicks will invariably die in the shell in the later stages of incubation if it is attempted to operate an incubator under such conditions. *The essential of incubation is absolutely quiet and relatively pure air surrounding the eggs at all times.* Any change in room temperature always alters the amount of air passing through the incubator. In our practice it has been found that with an incubator temperature of 102 degrees and room temperature of 65 degrees, there is enough difference to secure a slow but certain exchange of air to carry off the carbon-dioxide through a moderate opening of the ventilators.

But it is by no means easy to get a room in which the temperature does not vary considerably between the night and noon hours; it is therefore absolutely necessary to look after your ventilators in proportion to the change in room temperature. Generally they need to be

open much wider during the day than during the night. There is no other certain way to know whether the air in your machine is sufficiently pure than by means of our carbon-dioxide test. This test has now been so perfected and simplified that it is as convenient and reliable as a thermometer, and its use is fully as important, if you do not want to hatch by guess-work. It has taken many years of almost unceasing labor and experiment to perfect this invention and bring it to its present state of simplicity and efficiency, but it has removed the last remnant of uncertainty about hatching.

Diagram of the P. Cook Carbon-Dioxide Test.

a—Graduated piston rod.

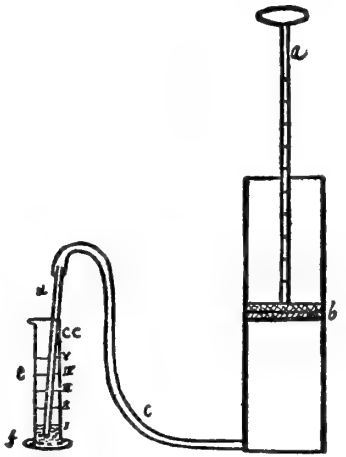
b—The air pump.

c—Rubber tubing.

d—Glass tube.

e—Ordinary 5 cc graduate.

f—Lime water.



DIRECTIONS FOR THE USE OF THE P. COOK CARBON-DIOXIDE TEST.

1. This test depends upon the principle that the carbon-dioxide given off in the respiration of living embryos will discolor, or make milky, clear lime-water when the gas is passed very slowly through it. The amount of precipitation depends in a fairly even ratio upon the amount of carbon-dioxide present.

Now, if we have an instrument by which we can pass an accurately measured quantity of impure air through a measured quantity of clear lime-water, we can form an idea of the relative purity or impurity of the incubator air by the amount required to make the test fluid milky.

2. *How to prepare the lime-water.* Take a pint glass jar full of water. Drop into it a piece of unslaked lime the size of an egg. Let it stand for an hour, and then stir thoroughly. Let stand again till water on top becomes perfectly clear. Always use this clear water on top. In a day or so, a crust will form, which does no harm, but use

only the clear fluid underneath. Once a week stir the solution from the bottom to keep it at full strength. Add more water when your fluid evaporates too much, and renew the lime once in six months.

3. *The testing instrument* consists of an accurately graduated air-pump with attachments for withdrawing the air from the incubator and passing it through the lime water. On the piston, or plunger, of the pump will be found three graduations marked 50, 75 and 125. These indicate the number of cubic centimeters of air which have been passed through the testing fluid by depressing the plunger till the fluid begins to show milky. In practice, however, you need pay no attention to these figures, but in the space between the figures 75-125 you will find the figure 2. This means that for the entire second week of incubation your ventilation should be found somewhere in this space; it will differ from day to day and gradually approach the lower figure, but anywhere in the entire space between 75-125 will be safe for that week. If you go below 75 for that week, it is not enough ventilation; if your incubator goes above it, it has too much draft in it. Open or close your ventilators to come within the safe limits.

Similarly, between the figures 50-75 you will find the number 3. This means that normal ventilation during the third week should stand somewhere between 50-75 c.c. But never, under any consideration, let your ventilation go below 50 for any length of time. Your chicks will die fast in the shell from suffocation in carbon-dioxide. A few hours in an atmosphere much below fifty may kill fifty per cent of the hatch.

It is important that your pump works properly. The instrument we furnish will last a life-time with ordinary care. Keep plunger oiled with sewing machine oil and occasionally unscrew top to spread the leathers or renew them. Pump should work smoothly and reasonably easy, but it cannot be relied upon when it works too loosely.

4. *How to make a test.* Bore a small hole through door, or top, or side of incubator and introduce the glass and rubber tube through it to within a few inches above the eggs and about twelve inches away from the door. Get the air from somewhere near the center of machine. Now fill your pump with incubator air *by drawing out plunger very slowly, but with an even stroke, and be very careful to draw it out clear to the very end,* otherwise your pump does not measure right.

Next fill your glass graduate with exactly one cubic centimeter of clear lime water, i. e., fill the glass graduate to the figure 1 near the bottom, or in case we furnish plain vials, to the line near the bottom. (Always read it at the curve of the meniscus, for the glass draws up the fluid somewhat on the edges.) Use the medicine dropper to transfer your lime water from the glass jar to the graduate.

Now put the glass tube attached to the rubber tubing of your air pump down in to the lime water in the graduate. Press down the plunger very, very slowly, so as to pass the incubator air through the

testing fluid (one bubble at a time, but try to keep an even pressure on the plunger). Keep passing the air through till your lime water begins to turn cloudy or milky. Stop as soon as you can clearly see that the fluid is changing color. Now read the figures on your plunger. If your hatch is in the third week and you find your plunger depressed far enough to stand somewhere in the space between 50-75, your incubator is working all right. If it did not go down as far as 50, you need more ventilation. If it went farther than 75 you have too much draft in your machine and must close some of its ventilators.

The same holds good for the second week, except that your plunger must stand between 75 and 125.

CAUTION—Do not put your glass-graduate in too bright a light. Reflected moderate daylight is best. Find some place where you can readily detect the change in color. It is well to use a large sheet of dark dull paper on top the incubator or wherever you put the glass-graduate. Before testing your incubator try to become familiar with the working of the instrument. You can try it on your own breath, or take the air above a lamp flame or gas jet.

After a few tests the glass-graduate will become milky. This can readily be wiped out with a rag on a stick, or, better still, fill your glass-graduate with common muriatic acid. This will instantly clear it. You can use the acid over and over again for a whole season. But take great care to rinse the graduate thoroughly of the least trace of acid, or it will neutralize your lime water. Rinse several times in clear water, followed with a dropper full of lime water.

The test now is simplicity in itself, but nevertheless it took us seven years of hard work to find the proper values for the second and third weeks of incubation. Our graduations represent the best mean of the physiological limits of the egg. If a setting hen is tested, she will often be found to vary considerably from our figures, but if you take the trouble to make fifty or a hundred separate tests of setters and average the readings, the result will always be found to fall within our figures, never outside of them. It must also be remembered that somewhat purer air is necessary in the incubator than under the hen, for the hen only has a small clutch of eggs, whereas the hundreds of eggs in an incubator easily produce a cumulative effect in carbon-dioxide poisoning. The slighest shift of position or lift of her feathers completely airs the eggs of the setting hen.

COMMON SENSE CONSIDERATIONS.

It must be remembered that this test can only show the relative amount of carbon-dioxide present in the incubator at the time of testing. When the eggs have been aired it will necessarily take several hours before this new air in the incubator becomes appreciably contaminated. *So the test must always be made at the time when the doors have been closed longest and before they are opened.* With the opening of the door the carbon-dioxide escapes almost immediately. Again, as the

germs grow day by day they breathe more and more and the greater is the quantity of carbon-dioxide which they give off. For that reason continually progressive ventilation is needed. For the first week the germs are so tiny, and give off so little carbon-dioxide, that they can never contaminate the air in the machine. In the first week they are also the most sensitive to strong air-currents and it is of the greatest importance therefore that there is absolutely no ventilation at all. Stop up carefully every opening, ventilators, cracks, etc., in the top or around the door, etc. All you need to do during the first week is to take the eggs out twice a day to turn them and shift their position. This opening of doors will renew the air sufficiently within the machine. Be very careful this first week not to chill the tender germs.

There is no need to test your incubator for ventilation the first week, and our instrument is not designed to measure the small amount of carbon-dioxide found at this time. Remember only, all ventilation in the incubator during the first week can only do harm.

For the second and third weeks keep your ventilation according to our instrument. It is designed for the maximum amount of impurity that should ever be allowed to accumulate within any 12 hours. Under no consideration should an incubator ever be left closed for more than 12 hours without a complete renewal of air. And this means from the very beginning till the very end of the hatch.

Again, the instrument is based upon the supposition that your incubator is operated in a room of from 65 to 68 degrees, and that the test is made either in the morning or at night before the eggs are turned or the foul air has been changed. If your room temperature does not vary much from 65 degrees, a couple of tests during the second week and again a couple during the third week is all that is necessary.

If, however, your room temperature varies very much, the state of affairs is altogether different. Should your room temperature jump to 85 or 90 at noon, then all ventilation stops and you must make another test at that time. If at noon your machine already shows what is proper only at the end of twelve hours, you must open your doors and change the air completely, especially the last week. Look out for a hot spell; naturally your mcahine will overheat and you will no doubt turn out your lamp, but far, far more important is it to give your eggs air; nothing will do in hot weather except to keep your doors partly or altogether open. In a hot spell be sure to test the air of your machine every two or three hours, and remember that a hot night is as bad as a hot day. A thunderstorm will do no harm to your eggs, but the heat preceding it may be fatal. If a hot spell strikes you at hatching time, open your incubator doors and leave them open. See that your chicks have air at that time. If ever they need it, it is at the time they are working to get out of the shell; it takes plenty of oxygen to give them the necessary strength. Remember, whenever your room temperature goes above 85 degrees your ventilators cease to work and the only

recourse is to open the doors often enough to renew the air. Have hen-sense in this matter. In hot weather she raises from her eggs and stands on them with wings lifted above them.

There is no harm in double, or triple-decking machines, but the upper tiers will need three or four times the amount of ventilation which the lower tier requires. The air-strata surrounding the upper tiers in the incubator room are likely to be much warmer than those surrounding the lower tier, hence the need for more ventilation in the upper tiers. If trays can be conveniently interchanged, hatch your chicks in the upper tiers in cold weather. The bottoms are warmer there and chicks need a sufficiently warm nursery. If there is trouble in hatching in the double-deck machines, our carbon-dioxide test will show you how to remedy it.

THE BIOMETER TEST.

A modification of this carbon-dioxide test is available now for testing the vitality of single embryos. The stronger the chick breathes, the greater its vitality. This can be tested by the amount of carbon-dioxide given off. Owing to the small quantities of air available for the test, the methods must be much more refined and the process is much more intricate, therefore I am not describing it here. Full directions are furnished with the instruments.

This test is useful in studying the effect of feeds, of inbreeding, of early and late eggs from a laying cycle of the hen, etc. It is the key to much useful information, but it will take many years and much painstaking labor to make the data available. A good subject for a Ph. D. degree for some ambitious young student.

MOISTURE.

Among the popular beliefs concerning incubation is that moisture is very important. I have myself spent years of labor on this theory only to find in the end that moisture is the least important of all things affecting the incubation process. Eggs hatch equally well in atmospheres of thirty to ninety per cent humidity, provided the incubating chamber is draftless. If the ventilating system carries strong air-currents through the machine, that is a different matter, and these drafts may seriously injure the growing embryos by depriving the eggs of their natural moisture content.

Embryos cannot develop properly unless they can grow in the natural moisture-content of the egg. This must not be disturbed. The size of the air-cell is never an indication of the moisture requirements of the growing embryo. If the embryo is growing vigorously it uses up the water content of the albumen in building its body. Part of the moisture of the egg may also be lost in respiration. All this must take its natural course, and there should be no attempt at any "drying down" of eggs, as advised in certain sections of the country.

I may as well state here that apparently the air-cell plays no important part in the respiration of the embryo. I took a dozen White Leghorn eggs once and covered one third of the large end of the egg with several coats of shellac to determine this question. All these eggs produced perfect chicks. More than likely, the air-cell at the large end of the egg serves as an insulator against cold, for under the hen, eggs naturally arrange themselves in the nest so as to turn the air-cell end towards the outer edge of the clutch, exposing them more or less to the outer air. The air-cushion at this end helps to keep in the warmth of the emryo as received from the setting hen.

This air cell forms a dead air space and heat or cold can penetrate it only with difficulty. For this reason eggs in an incubator should never be stood up straight with the air-cushion intervening between the egg and the cource of heat, for it is very difficult to heat through this. It is true that eggs will hatch, both under the hen, and also in an incubator, no matter in what position they lie in the nest or on the tray. Nevertheless, the normal position for an egg, both in the nest or on an incubator tray, is to lie flat on its side with the big end slightly elevated. In the end it will pay well to place eggs and keep them as far as possible in this position. The most unnatural position for the egg is with its small end upward, yet a day or two in this position seems to do no particular harm.

To return to the moisture question. Sprinkling of the eggs can never do them any good, it only gives them a bad chill and should never, under any circumstances, be practiced, not even on duck eggs. In fact, all moisture applied for a short time to the exterior of the shell can never penetrate to the interior, but it shuts off for the time being the air supply and may drown or suffocate the embryo. An egg com-

pletely covered with a water film is as effectually sealed against air as if it were at the bottom of the ocean. Therefore, wetting the eggs during the last days of the hatch is an exceedingly dangerous proceeding. Remember, the embryo breathes through the entire surface of the egg-shell and no part of this surface should have the pores clogged or sealed. The least breathing, however, takes place at the large end where the air-cell is.

Equally useless is the sprinkling of the floor of incubator cellars or placing pans of water under the incubators. These things have no effect whatever on what goes on inside the incubator.

The best place to operate an incubator is a comfortable room with plenty of light, air and sunshine, a room in which it is a pleasant place of the operator to live. A wooden floor is far better in a hatchery than a cement floor. A cellar has no advantage, except for poor incubators that have not sufficient range of heating and ventilating systems. If the incubator is constructed properly, a building above ground is far more preferable. A building comfortable for human beings to live in is also the very best kind of a building for operating incubators. Make it comfortable for yourself and you make it comfortable at the same time for the chicks.

Here I might say, however, that with the most common type of Mammoth incubators on the market at present, which depend upon the regulation of the temperature of the individual sections by letting out the surplus heat by means of a damper over a large opening in the center, it is absolutely necessary to keep moisture pans underneath the trays filled with water, for these machines have far too much draft in them. They cannot operate successfully in carrying off surplus heat without a great excess of draft and therefore it is of the highest importance that fully saturated moist air be taken in. This excess draft is the great draw-back to this otherwise excellent type of construction.

Too much moisture, however, becomes very harmful at hatching time. The emryos come wet out of the shell and chicks cannot dry properly in a completely saturated atmosphere, besides, breathing is much more difficult. If the room in which incubators are operated is about 68-70 degrees temperature, no moisture should be allowed to collect on glass doors. This shows too much moisture in the hatching chamber and more ventilation must be given or doors opened to carry off the excess moisture. Nothing is so detrimental to chicks as a wet hatching chamber, wet incubator bottom, etc. They will invariably chill if taken from such an incubator to a brooder or chick box. Hatching chicks in too wet a chamber is one of the fruitful causes of diarrhea in the brooder. Under the hen the excluded chick drys very rapidly and it has its beak out in the fresh open air through the hen's feathers in no time. If a chick is extra long in getting out of the shell under the hen, the egg-membrane will be found quite dry around it. These conditions must also be maintained in the incubator. Do not try to steam

out the chicks. If chicks are too long in getting out of the shell, they will dry up under the hen and that also should be the case in the incubator. These chicks that dry up are generally weak, or they would have gotten out in proper time. If they are merely caught by accident, they can be helped out of the shell by breaking the strands of the membrane and the chick will be found perfectly formed and normal. These cases, however, are so few that they can safely be neglected. A poor hatch can never be helped by giving it moisture during the last few days, and it can safely be said that no hatch ever suffered for lack of moisture, except where the incubator was too drafty.

Forget the moisture. It has nothing to do with incubation. Or rather, the range under which eggs hatch is so wide that it is almost impossible to transgress it. The moisture gauges on the market are generally utterly unreliable. If you wish to know what goes on inside your machine, get an accurate dairy thermometer, reading down to 75 degrees. Tie a couple of layers of cheese-cloth around the bulb. Have your incubator at 102. Then dip the dairy thermometer bulb in lukewarm water. Shake off the surplus water. Then insert this thermometer into the egg-chamber through a hole in the door, (or top, or wall) with the bulb near the eggs. Wait five or ten minutes, then watch the thermometer and get its lowest reading, which will be just before the cheese-cloth becomes entirely dry. If it reads about 90 degrees while your incubator thermometer reads 102 the moisture is all right (it is in this case about 65 per cent humidity). If your dairy thermometer reads 85 or less the machine is rather dry, but a few days at this will not hurt, especially if the humidity rises at night. If on the other hand your dairy thermometer reads 95 degrees, the machine has excessive humidity, but it is not particularly harmful if you have sufficient ventilation.

GENERAL CONSIDERATIONS.

It is of the greatest importance to set eggs not more than one week old. The fresher the eggs, the better. In keeping eggs for hatching it is best to place them in an ordinary egg case. However, they should not be packed while still warm from the nest, since this heat is enough to start the germs if a case is filled with them. Neither should hatching eggs ever be placed on a screen to cool them. That cools them too quickly. Eggs for hatching should be gathered in small baskets. Let them stand over night in a cellar with a temperature between fifty and sixty degrees. Then pack them next morning and leave case in cellar. Turning the cases or eggs while being kept for the incubator is of no use.

On account of the intensive methods of poultry-keeping the vigor and vitality of the breeding stock has been greatly decreased. Insane methods of forcing and feeding also have worked havoc with breeding stock. Sexual overstimulation everywhere in nature is penalized with weakened off-spring. For this reason the victors in an egg-laying con-

test make the poorest breeding stock, and, worst of all, are males raised from such ancestry. Only the fact that nature, and the hen in particular, has great powers of recovery, prevents complete collapse in poultry-breeding by these methods. But there is no quicker road to extinction in the poultry industry than line breeding from the three hundred egg birds.

In fruit-growing practically all our finest and most prolific fruits are grown on wild or sour stock roots to maintain vigor. The seeds from a seedless orange will not produce a paying orange grove. It is true, infertile eggs are good storage eggs, but they cannot replenish the breeding stock.

The time must come when every poultry raiser will give his breeders particular care. Both pullets and cockerels must be prevented from too early maturity and too early mating. Pullets should not be mated till they have passed through a complete moult and they should not be allowed to lay too many eggs in their pullet-year. A wise orchardist never allows his trees to bear too young, nor too heavy a crop in the early years.

Pullets intended for breeding should be fed no egg-mash in their first year, nor so long as they are intended for breeders. Too heavy laying in the breeding season is detrimental to the off-spring.

Plenty of green feed, fair range, a fair supply of raw, fresh meat, and a little sour milk or buttermilk are the essentials for the production of fertile eggs.

Cockerels are in their prime from 12 to 24 months of age. Hens in their second and third laying season. Frequent introduction of new blood is nature's way of maintaining vigor. It takes hens of extreme vigor to maintain flock-records of 175 to 200 eggs in the pullet year and to approach 150 eggs in the second and third years.

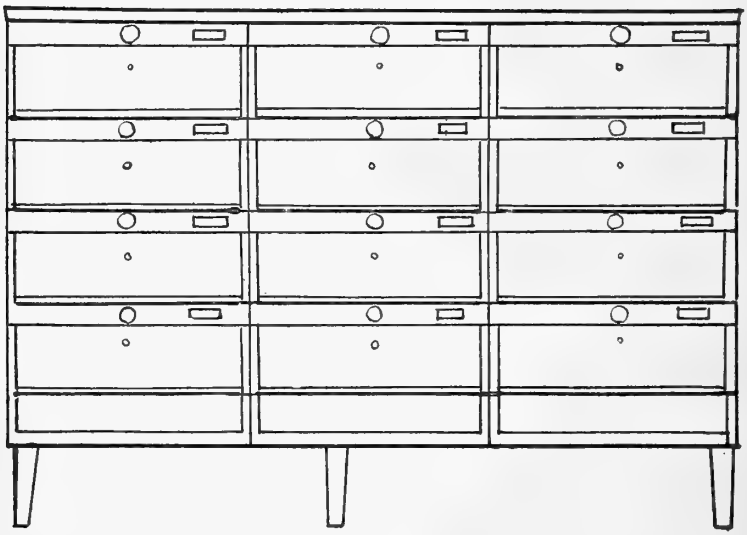
Brooding chicks in flocks of more than 100 chicks to the run is simply another way to raise a lot of culls and weaklings. Chicks intended for breeding flocks should be raised in the open air and sunshine. If the poultryman has no "hen-sense" in this matter, he had better go back and let the setting hen raise all his breeders. Better breeding stock means a great deal more than trap-nest record or a pedigree. Some day poultry men will realize that it is not the dam's or sire's record which fills the pocket-book, but the amount of eggs his pullets or hens will lay.

THE P. COOK SECTIONAL ELECTRIC INCUBATORS.

Our new sectional electric incubator is an altogether new invention in incubators. It possesses the great economical advantage that all sections are identically alike, holding from 250 to 300 hens eggs. They can be stacked directly on top of each other, and side by side, like a sectional book-case or card-index case. Yet each section is absolutely independent of the others, one secton can be run at a time or all sections at once. Each section is complete in itself, with its own thermostat, heating elements, etc., and only such sections as are used are switched on.

However, the more sections are stacked together and in use, the less current consumption per unit, as the heat given off by the embryos penetrates to other sections and thus cuts current consumption almost to nothing when a large battery is operated.

Coal oil lamps are furnished which can maintain sufficient temperature to save the eggs in case there is an accident to the electric heating system.



FRONT-ELEVATION OF A BATTERY OF P. COOK SECTIONAL ELECTRIC INCUBATORS.

Three sub-sections, with four incubating sections over the subsection, each section holding 300 eggs, a total of 3600 eggs in this battery. Floor-space is about 3 feet wide and 9 feet long. The four section high battery is 68 inches high from the floor.

These incubators are producing far superior hatches to all others I have ever operated, delivering hatch after hatch without culls of any kind.

As will be seen from the front elevation, the upper sections receive whatever heat filters through from the section below. Thus the temperature below the egg tray is around 95 to 100 degrees (regulated by false bottoms).

Below the first section there is a blind half-section which is heated, (but not used for incubation) to give the necessary bottom-heat to the first section.

Everything about the machine is automatic. The doors have automatic catches. Eggs are turned with our automatic turning tray and are never lifted out of the machine or shifted in any way. Any woman can operate this machine without back-aches.

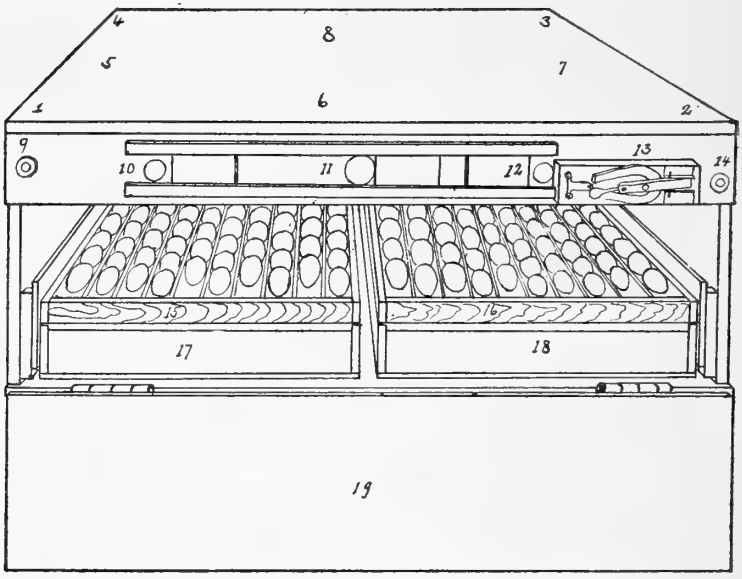
Though it does not seem necessary, yet as an extra precaution we are leaving off one egg from the trays in each corner. This leaves greater opportunity for the heat to circulate all around the eggs.

Since this machine has from 95 to 100 degrees heat underneath the eggs, it is possible to place eggs on the trays with large end elevated 45 degrees. Thus the machine will hold 300 eggs instead of 250. However, eggs should be tested out for infertiles on the fourth or fifth day and then should be laid more nearly flat.

Our experiments have given no positive proof that eggs hatch better when laid flat on the trays, but there can be no doubt that this flat position (with the large end slightly elevated) is the normal position of the egg in the nest, and nothing should ever be done to transgress nature's ways. Success can be expected only when we work in complete harmony with nature.

In the long run, the poultryman who works in harmony with nature will find the path to success far easier, than he who transgresses her laws. In fact, the most successful man anywhere is he who follows nature the closest.

THE P. COOK SECTIONAL ELECTRIC INCUBATORS.



[*Patent applied for*]

Description of Diagram:

Nos. 1-4, the four main heating elements in the corners; 5-8, the supplementary heating elements, not used after the 12th day. 9, switch controlling the supplementary heaters. 10 and 12, supplementary ventilators for use in hot weather. 11, main ventilator, for use up to room temperature of 70 degrees. 13, magnetic circuit breaker and thermostat. 14, main switch of the section. 15-16, automatic egg-turning trays. Notice the half-inch air-space between tray and wall surrounding the egg and allowing free circulation of heat. 17-18, nursery-drawers. Both drawers and turning trays can be pulled out together, or turning tray can be lifted off first and drawers with chicks pulled out afterwards. 19, drop-door of section.

In addition each section has its own rheostat (behind Fig. 9) by which the temperature can be still further controlled.

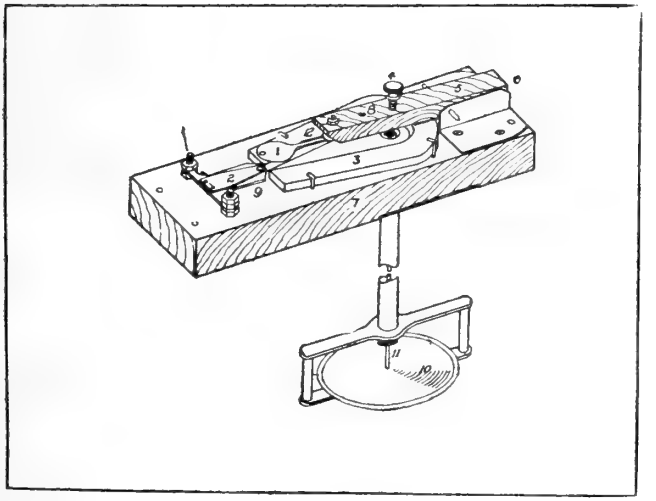
The heating elements give off only a very mild heat, comfortable to the touch of the hand.

It will be seen that eggs in this machine are under far more ideal conditions at every point than they have ever before been in an incubator. Hence the superior hatches. We give this full description here primarily to illustrate the principles which must be complied with in

successful incubation and the reader may apply these principles to his own incubators as best he can.

However, many parts of the machine, and especially the unrivalled circuit-breaker, have patents pending, and persons intending to build new machines should consult us, so as not to infringe patents. We will do all we can to aid everybody to get his incubators at the least expense.

THE P. COOK MAGNETIC CIRCUIT-BREAKER.



[*Patent applied for*]

This is an extremely efficient electric thermostat. The magnet holds the points securely together while there is contact. A spring makes a sudden break and keeps the points 1-16 of an inch apart until the magnet suddenly closes the circuit again.

As we have applied for a patent for this, therefore no description is necessary. It is too delicate to be manufactured by unauthorized persons. Persons wishing to use it on their own incubators should consult us. It is sold at the lowest possible price of manufacture. It lasts practically a life-time.

Also the P. Cook Carbon-Dioxide Test and the Biometer Test are for sale by the author.

Address all communications regarding them to P. Cook, 1717 Valley Boulevard, Alhambra, Calif.